HapSeat: a novel approach to simulate motion in audiovisual experiences

Fabien Danieau, Julien Fleureau, Philippe Guillotel, Nicolas Mollet, Marc Christie, Anatole Lécuyer

HapSeat: a novel approach to simulate motion in audiovisual experiences

Fabien Danieau* Technicolor
Julien Fleureau Technicolor
Philippe Guillotel Technicolor
Nicolas Mollet Technicolor
Marc Christie IRISA
Anatole Lécuyer Inria

Abstract

The *HapSeat* is a novel and inexpensive approach for simulating motion sensations in audiovisual experience. Multiple force-feedbacks are applied to the sitting users' body to generate a 6DoF sensation of motion as users are experiencing passive navigation. A set of force-feedback devices (a headrest and mobile armrests) are arranged around a seat so that they can apply forces to the user. Several video sequences highlight the capabilities of the *HapSeat*. We propose SIGGRAPH attendees to experience these videos enhanced by haptic effects of motion.

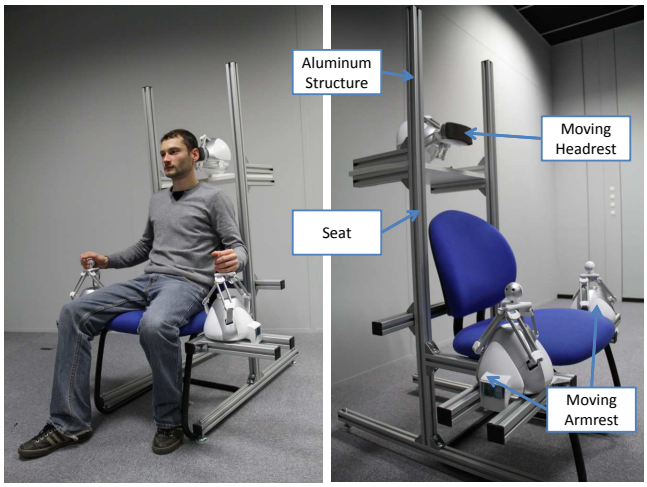

Figure 1: *Prototype of the HapSeat.*

1 Toward motion simulation in consumer settings

Motion simulators are well-known devices designed to create a feeling of motion. They are intensively used in driving or flight simulators for training purposes. Most are based on a Stewart platform, a 6 Degrees of Freedom (DoF) platform driven by 6 hydraulic cylinders. This technology, mainly used in virtual reality settings, is gaining interest in entertainment applications through video games, amusement parks or "4D cinemas". We believe that the next step of this evolution could be the use of motion simulation in consumer environment (to enhance the home cinema experience for instance). Though Stewart-based motion platforms provide a realistic sensation of motion they remain expensive for mass market and they are not suitable for consumer settings. Simpler setups based on force-feedback or vibrating devices would be more adapted but they trigger only basic sensations.

To fill the gap between these two categories we propose the *HapSeat* [Danieau et al. 2012]. Instead of moving the whole user's body as on motion platforms, only some parts of the body are stimulated. The perception of motion results from the stimulation of different parts of the body (vestibular system, visceral organs, kinesthetic system). Our approach is built on the hypothesis that local forces can generate a global sensation of motion. A prototype has been created, relying on 3 low-cost actuators held by an armchair-shaped structure. Two of them stimulate the user's hands while a third one stimulates the head (Figure 1). The originality of this work lies on: a novel approach for motion simulation replacing expensive motion platforms by multiple low-cost force-feedback, the design of a new device, and the development of a new control algorithm.

*e-mail: fabien.danieau@technicolor.com

2 The HapSeat demonstration

We invite the SIGGRAPH audience to discover this new type of motion simulator. The user comfortably seated on the *HapSeat* will experience videos enhanced with haptic effects of motion. In order to illustrate the capabilities of the *HapSeat* we propose four one-minute sequences.

The Horse Ride - A camera coupled to an inertial measurement unit (IMU) has been fixed on a horse rider's torso, resulting in a first person point-of-view video of a horse riding session. Using the data from the IMU, the rider's movements are rendered on the *HapSeat*. The user will feel as he is riding an actual horse!

The Rollercoaster - With this sequence the user will enjoy the exciting sensations of a rollercoaster. The *HapSeat* will provide realistic vibrations and motion effects.

The Spaceship - The user will board a virtual spaceship navigating through the galaxy. This sequence shows a 6DoF movements rendered by the *HapSeat*.

The 4D Home Cinema - This last scenario shows the capabilities of the *HapSeat* to enhance a classical movie. Various haptic effects are rendered: vibrations, force-feedback, motion.

3 Results and Perspectives

A user study has been conducted to evaluate the quality of the simulated movement and its impact on the quality of the video viewing experience [Danieau et al. 2012]. Participants reported that the simulated motion was consistent with their real-world experience and they experienced a sensation of self-motion. In general we observed that quality of experience is increased by the *HapSeat*. This device was tested by 100 people during several internal events at Technicolor and we received enthusiastic and positive feedback from the audience.

This new way of simulating motion in a consumer environment opens the path to novel immersive applications. The prototype is not limited to motion simulation but can also provide force-feedback and vibration effects which enable even more creative possibilities. Furthermore the input capabilities of the actuators could be used to allow the user to interact with the simulation, offering the prospect of extending applications of the *HapSeat* to flight or driving simulators, teleoperation and more!

References

DANIEAU, F., FLEUREAU, J., GUILLOTEL, P., MOLLET, N., CHRISTIE, M., AND LÉCUYER, A. 2012. HapSeat: Producing Motion Sensation with Multiple Force-feedback Devices Embedded in a Seat. In *ACM VRST*, 69–76.